Sweet Corn

ATLANTIC PROVINCES VEGETABLE CROPS GUIDE TO PEST MANAGEMENT 2002 - 2003

Agriculture and Forestry
Farm Extension Services

Distributed By:
FARM EXTENSION SERVICES
P.E.I. DEPARTMENT OF AGRICULTURE AND FORESTRY

Publication No. 1400A
Agdex No. 250/600
Published January 2002

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Introduction

Sweet Corn is a member of the Gramineae (grass family) *Zea mays var rugosa* is an annual grass which can grow up to 4 meters in height. Male flowers are contained in the tassel and female flowers in rows on a thick cob. Sweet corn is distinguished from other corns by its high sugar content when in the milk and early dough stages and by its wrinkled translucent kernels when dry. It differs genetically by a single recessive gene. Sweet corn cultivars come in 3 colors yellow, white and bicolor. Corn is thought to have originated in Mexico and been domesticated over 5000 years ago. Present day varieties of sweet corn had their introduction around the 1850's in the United States.

Sweet corn requires a minimum soil temperature of 13&degC for germination and root development. (Soil temperature optimum range 21&deg to 27&degC). Corn responds well to warm conditions (optimum air temperature 21&deg to 30&degC). Corn growth increases with temperature up to 30&degC after which growth response decreases. Corn heat units can be used to assess the normal rate of growth for sweet corn (10&degC base temperature). Cultivar selection based upon corn heat unit requirements to reach expected maturity can be matched to normal corn heat unit values expected at a location. Sweet corn production can be accelerated by planting the seed in plastic covered trenches. This crop is sensitive to frost but if the growing

point is not frozen then the crop may regrow normally. Corn requires a good, even supply of moisture. Irrigation particularly at the time of pollination and early kernel formation may improve quality and yields of this crop. Frost control may be achieved through solid set irrigation systems for corn maturing in late September and early October. Sweet corn produced in more northerly climates is sweeter than that produced in the south.

A well drained soil with good water retention is desirable. Sandy loams, loams and silt loams, high in organic matter, are best suited to this crop. Corn is a shallow rooted crop. Flooding is injurious to corn plants yet water stress is also detrimental to plant development.

Harvest of early sweet corn cultivars occurs in late July, and late corn crops are usually harvested by early October. The peak of the sweet corn season is usually the last week in August when demand and supply are generally the highest. Yields of 2000 to 3000 dozen per hectare are typical (6000 to 10,000 kg per hectare). Early cultivars are lower yielding than late cultivars.

Presently most sweet corn is marketed through roadside stands, farmers markets and delivery directly to wholesalers. There may be some specialty markets for high quality corn such as in the H.R.I. trade and convenience fresh packs.

Nutrient Content: Provides Carbohydrates, potassium and folate; fair amount of Vitamin A as well as other nutrients to the diet. 1 ear contains 70 kilocalories; 250 mL (1 cup) kernels contains 148 kilocalories.

Crop Establishment

Early Sweet Corn cultivars need 1900 CHU's, mid season cultivars need 2000 to 2100 CHU's and late season cultivars 2200 to 2300 CHU's. Late cultivars can usually be grown successfully in the most favorable climate areas of the Atlantic Region.

Seed Treatment - Do not plant cultivars early which are known not to have seed cold hardiness as seed decay may result in poor stands. (1) Plant when soil temperature is above 18&degC. (2) Use seeding rates 20% higher than normal. (3) Plant shallow. (4) Plant into moist ground. (5) Handle seed carefully as kernels can crack easily. (6) The use of plastics usually improves germination. Treatment of seed with a bird repellent should be considered against the removal of the seed and/or plant by birds. (7) Special seed treatments may be available on certain cultivars.

Normal Sweet Corn: Are the traditional cultivars that have been available for years. These cultivars contain the 'su' gene. They have normal sugar levels and convert their sugar to starch quite quickly.

Sugar Enhanced Sweet Corn: Contain the 'se' gene. They have higher sugar levels and they also convert their sugar to starch. But because they have higher sugar levels to start with, they remain sweeter longer. 'SE' means that 100% of the kernels on each cob will have enhanced sugar levels. 'Se': only 25% of the kernels have the higher enhanced sugar levels.

Supersweet Sweet Corn: Contain the 'SH2' gene. They often have the highest sugar levels of all three types. They do not convey sugar to starch readily and therefore stay sweet the longest. Cultivars with the 'SH2' gene tend to be more difficult to grow, but a crunchier corn to eat.

SeSS & SH2SS Sweet Corn: Cultivars that have these gene types have been bred to improve cold soil germination. The 'SS' means that they have about 25% 'Normal-su' genes. The rest of the genes are either SE or SH2.

All these new cultivars express their high sugar levels best when grown in isolation, away from both field corn and regular sweet corn. Isolation is most critical with cultivars containing the SH2 gene: e.g. 'Crisp and Sweet'. Isolation can be obtained by growing these cultivars 75 metres away from other corn. These cultivars can also be considered isolated if the corn grown within 75 metres has a 2 week difference in tasselling time.

In scheduling a supply of corn for an extended market period, it is usually preferable to plant a number of cultivars which mature at different times, rather than attempting to plant one or two cultivars at different times.

Seeding/Planting - Depth of seeding should be no greater than is required to maintain a cover until emergence usually 1 to 2.5 cm, depending on the soil type. Row spacings are usually determined by equipment, closer row spacings usually result in increased yields, provided moisture and fertility are not limited. Too close a spacing between plants reduces ear size and may result in no marketable ears in crowded stands. For early cultivars, rows should be about 75 cm apart, and plants 15 to 20 cm. For tall, late cultivars, rows about 90 cm apart, and plants 20 to 30 cm. Depending on the seed size this usually requires 11 to 17 kg of seed per hectare to produce 50,000 to 85,000 plants per hectare.

Minimum soil temperature for germination depends on the cultivar. In general, Su cultivars require 13&degC, SE's 16&degC and SH2's 18&degC.

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Clear plastic mulch can be used to advance the maturity of the corn by 10 to 14 days. Germination and yields are usually increased. Prepare the seed bed, apply fertilizer, work broadcast fertilizer deep enough to allow for trench depth, make trenches, sow seed in the bottom of the trench, band some fertilizer at seeding if desired, apply a herbicide and then cover with the plastic mulch. Two rows spaced about 40 cm apart are usually covered with a strip of plastic 1.2 m wide, pairs of rows are then spaced 1.5 to 2 m apart depending on the equipment. Seed is planted in furrows 10 cm deep and about 15 cm wide at the top. This allows space for plants to grow until the plastic is removed. Some holes about 1 cm in diameter should be made in the plastic to allow rain to penetrate and provide some ventilation. This is usually done by drilling into the roll to coincide with the seeded rows. The plastic is removed soon after the plants come in contact with the mulch.

Do not use high levels of residual herbicides on this crop if field rotation is planned

the following year.

Cut corn stubble with a rotary mower while the corn stalks are still green and plow this green material into the soil. Establish a cover or green manure crop if possible to stop erosion and/or provide more green manure.

Nutrition ▲ to Top

ALL ADDITIONS OF LIME AND FERTILIZER OR MANURES SHOULD BE BASED ON RECOMMENDATIONS FROM A SOIL TEST.

Sweet corn requires high fertilization. Manure is a valuable material and 20 to 40 tonnes of manure per hectare may advantageously be substituted for part of the fertilizer.

Lime - Lime should be applied to maintain the soil pH in the range 6.0 to 6.8 for best results. Corn will tolerate a pH as low as 5.5 where the soil contains good levels of calcium and magnesium.

Nitrogen - Is the element usually most limiting crop quality and yields. Manures and moderate levels of nitrogen should be applied preplant. The maximum level of N plus K banded is 80 kg per hectare (actual). Nitrogen may be sidedressed but should be done early (before plant is 30 cm high). The corn plant's potential is determined at an early age.

Phosphorus - At least 50 kg per hectare of phosphorus should be banded. This will encourage earliness of production and increase the yield potential.

Potash - Response of corn to potash is that, with adequate feedings, ears are better filled to the tips and stalk strength is increased.

Magnesium - Is a common deficiency and can be corrected by applying sprays of epsom salts (magnesium sulphate) at 5.5 kg per hectare. This should not be necessary on fields properly limed with dolomitic limestone.

Sulfur - Where high rates of manures are not used on sandy soils with low organic matters one should consider the use of gypsum to supply an adequate soil level of sulfur.

Micronutrients - Zinc deficiency occurs in this region especially with cold wet springs and in fields with low soil organic matter, poor soil structure, and high levels of phosphorus. Where zinc is required it may be applied to the soil mixed in the fertilizer at rates supplying 4 to 12 kg of zinc per hectare. The higher rate should be sufficient for up to 3 years. Not more than 4 kg of zinc per hectare should be banded at seeding. Zinc may be applied as a spray at rates supplying 0.6 kg of zinc per 1000 L of water. A wetting agent should be added.
Boron deficiency may be a problem on coarse sandy fields with a high pH and low organic matters where boron has not been applied on rotational crops. Care must be taken that the crop is not injured by a soil or foliar application of boron.

Application Method - A portion of the nitrogen and phosphorus required should be applied at seeding in one of two ways:

(1) In a band 5 cm to the side and 5 cm below the seed. The rate of application in a band should not supply more than 75 kg nitrogen per hectare or a total of 120 kg of nitrogen plus potash per hectare in 75 cm rows. If urea is the nitrogen source, not more than 40 kg nitrogen or 80 kg of nitrogen plus potash per hectare should be applied, in 75 cm rows.

(2) Broadcast before planting -- A major portion of the nitrogen should be applied preplant or sidedressed before the corn is 30 cm high. A major part of the phosphate and potash may be broadcast and worked in before seeding in the spring.

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Weeds

Excellent weed control is possible in corn through the proper selection and use of herbicides.

When plastic mulches are used, preplant incorporated herbicides are usually not deep enough to control weeds germinating from the bottom of the trench, therefore a preemergence herbicide must be used. The herbicide Bladex has injured sweet corn grown under plastic mulch when excessive rainfall has caused flooding of the trenches.

An over reliance on atrazine alone will encourage the build-up of resistant weeds, especially annual grasses. To avoid this, growers should use an annual grass herbicide in conjunction with atrazine and practice crop rotation. The application of high rates of atrazine or simazine will result in residues in the soil that will cause injury on most rotational crops.

Diseases (fungi)

Leaf Diseases

- Rust and Eyespot

Characteristics: Rust begins as small raised pustules scattered over both surfaces of the leaves. The pustules rupture, exposing dusty, red spores and later black spores. The red spores are spread by wind and can infect leaves directly. The eyespot fungus causes small, elongated lesions with distinct yellow halo's. This fungus overwinters in corn debris.

Control: Damage is often light. Practice clean plowing to encourage rapid rotting of corn debris and rotate with other crops to help prevent disease build-up. Maintain high soil fertility and adequate weed control. Rotate crops. Plant cultivars with rust resistance.

Common Smut (fungus)

Characteristics: Common Smut causes glistening silver-white galls on ears, stalks, leaves or tassels. The interior of the galls turns into masses of powdery dark brown material (spores).

Control: Infected plants should be removed and burned as soon as they are detected. Rotate crops - do not monoculture sweet corn - a 4 year rotation should be effective.

Insects

Seedcorn Maggot

Characteristics: Small yellowish-white maggots 6 mm long with a pointed head end. The adult is a small grayish-brown fly. Maggots feed on seed, causing seed to produce a poor plant. They will also feed on roots; causing poor plant growth. Seedcorn maggots frequently attack deeply planted seeds.

Control: To prevent damage, sow seeds shallow in warm soil or apply a granular insecticide in furrow when planting to protect seed or use treated seed.

Wireworm

Characteristics: Early in the spring, adult wireworms (click beetles) lay their eggs around grass roots. The larvae hatch in about one week and will live for 2 to 6 years in the ground feeding on roots and seeds. The wireworms, or larvae, are yellow, white or darker shades of brown. They may be 1.2 to 4 cm long and have a hard, smooth surface. When a larvae is mature, it pupates in the fall. It then becomes an adult beetle and waits until spring to emerge. Wireworms are often numerous in land that has been in sod for several years. Wireworms are sometimes confused with millipedes which have numerous pairs of legs and coil up when disturbed. Wireworms have three pairs of legs, one on each of the three segments immediately behind the head.

Control: Avoid planting crops highly susceptible to wireworms in a field that has been recently in sod. Plant treated seed. Prepare fields at least 1 year ahead of planting by using insecticides and cultivation to reduce wireworm numbers.

European Corn Borer

Characteristics: The European corn borer is a flesh colored caterpillar, 2.5 cm long with brown spots and a dark brown head. The eggs are laid in clusters on corn plants. After they hatch, the larvae move to the tassel of the plant. The tassel frequently "breaks" (bends over sharply) because it has been tunnelled. The larvae then move down the stalk and enter either the side of the cob or the stalk itself. Damage to the ear makes it unsaleable.

Control: The corn borer can be controlled culturally by removing old stalks from the field to prevent overwintering and practising crop rotations. Fall plowing is also

beneficial.

Corn Earworm

Characteristics: Corn earworms vary in color from light yellow to green or brown. They have a yellow head and grow to almost 5 cm in length. The adult moths are carried in on weather frontal systems from the south-eastern U.S. They lay their eggs on fresh silks coming from the ear. The larvae climb up the silk and feed on the developing kernels. The corn earworm can be confused with the fall armyworm.

Control: The first appearance of adults may vary from year to year, as well as the number of moths that migrate into the area. Therefore, pheromone traps are important for detecting adults and determining when to spray. Control is generally effected by applying an insecticide 2 days after the first silks appear. This must be repeated at 3 to 5 day intervals or as necessary until the silks dry off. Spray should be directed so as to thoroughly wet the silks. This is best achieved by using a high clearance sprayer with drop nozzles.

Fall Armyworm

Characteristics: The larvae are generally tan colored, with stripes, smooth skin, indistinguishable from corn earworm. Early injury in whorls causes tattered leaves; later injury is confined to the tassels and ears with feeding on kernels at tip and base of ear. They also invade corn borer tunnels in stalks. The adults are migratory, overwinter in Central America and appear any time after late June. They are generally a greater problem following a cool, wet spring in the South Eastern U.S.

Control: The fall armyworm is controlled by spraying when damage appears on the foliage. Sprays applied for corn earworm control will also prevent fall armyworm injury in ears.

Potato Stem Borer

Characteristics: The potato stem borer, fully grown, is about 3.5 cm long and pinkish-white in color with a brown head. The larvae move from plant to plant increasing the damage. The eggs laid on the stems of grasses in August and do not hatch until June of the following year. Damage can be expected in June and early July.

Control: There is, at present, no insecticide that will give good practical control of this insect. Because the moth lays eggs chiefly on couch grass during late August and early September, control of this weed in particular and clean cultivation in general are important preventive measures. Avoid planting corn in narrow strips with grassy margins. Cultivate field boundaries, or spray with a chemical weed killer to reducc couch (quack) grass.

FOR INFORMATION ON VERTEBRATE PEST CONTROL (BLACKBIRDS, CROWS, RACCOONS) SEE FACTSHEET ON 'VERTEBRATE PEST CONTROL.'

Harvesting and Handling

Harvest at the thick milk stage. Whenever possible, harvest in the morning when the ears are cool. Market on the day of harvest especially if proper cooling is not practical. Sugar content decreases rapidly after harvest, but less so if the corn is cooled. Rapid lowering of the temperature in the ears (pre-cooling), can be achieved by hydrocooling, vacuum cooling wetted ears, or package ice.

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Sweet corn quality can be maintained fairly well for 4 to 8 days after harvest at a temperature of -0.5&deg to 0&degC, and a relative humidity of 95 to 98%, after precooling, but should be marketed as soon as possible. Because fresh sweet corn produces much "heat of respiration", it should not be handled or stored in bulk for long periods.

Bibliography ▲ to Top

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PEST	PESTICIDE (Formulation)	RATE Product	DAYS TO HARVEST	REMARKS
Weeds ▲ to Top				
Preplant Quackgrass and other perennials	ROUNDUP 356 Sn	2.5 to 7.0 L/ha	-	Apply in the fall or spring prior to planting. Annual weed control programs will be necessary to control weeds germinating after planting. For quackgrass control apply to actively growing quackgrass when at least 4 new leaves are present. The low rate (2.5 L/ha) will provide a minimum of one season control, while higher rates (4.75 to 7 L/ha) will provide longer term control. The low rate of Roundup should be applied in 50 to 100 L/ha water. If higher water volumes are used add a suitable surfactant. Wait 72 hours before plowing under. Best control of quackgrass is obtained when these herbicides are applied in the
	TOUCHDOWN 480	2.5 to 7.0 L/ha	-	
	GLYFOS	2.5 to 7.0 L/ha	-	
	ROUNDUP TRANSORB	2.5 to 7.0 L/ha	-	

				fall.
Preplant Incorporated (PPI) Primarily annual grasses	ERADICANE 800 EC	4.25 to 5.5 L/ha	-	Preplant incorporated on mineral soil only. Apply to a dry soil surface and incorporate within 15 minutes. Use low rate on light weed infestations or on light soils. Can be tank mixed with atrazine or Bladex for better weed control.
Preplant Incorporated or Preemergence Annual Grasses	DUAL II MAGNUM	1.25 to 1.75 L/ha	80	Can be applied either (i) preplant incorporated - immediate incorporation not necessary; (ii) pre-emergence - requires rainfall or irrigation within 7 days. Apply high rate on heavy soils or on heavy weed infestations. Can be tank mixed with atrazine, or BLADEX for better broadleaf weed control. Refer to label. PRIMEXTRA is a mixture of DUAL and atrazine or (iii) early postemergence for annual grass infestation including fall panicum control. Corn should be at spike to 2 leaf stage. Annual grasses at maximum of 2-leaf stage. Do not use oil or surfactants.
	FRONTIER	1.1 to 1.4 L/ha	-	Apply either as a preplant incorporated or preemergence. Use the higher rate when preemergence application is to be made.
Preplant Incorporated/Pre or Postemergence Annual grasses and broadleaf weeds	BLADEX 480 Su	Consult label. Rates vary depending on the timing of application or when used in combination with other herbicides.	-	Can be applied either (i) preplant incorporated, (ii) preemergence or (iii) postemergence (WP formulations only and do not use surfactants). Chemically related to atrazine but BLADEX has better activity against annual grasses, (except barnyard grass) can be less safe on corn and less residual in the soil. BLADEX can be used in combination with atrazine or some of the grass herbicides above. Read label for the many uses of BLADEX. Barnyard grass and Redroot Pigweed may escape.
	BLADEX 90 DF		-	
Preplant Incorporated/Pre or Postemergence Primarily annual broadleaf weeds	ATRAZINE 90 WP	Consult label. Rates very depending on the method of application or when used in combination with other herbicides.	-	Can be applied: (i) preplant incorporated, (ii) preemergence, or (iii) postemergence with a suitable surfactant. Atrazine promotes annual grasses, e.g. barnyard grass, crabgrass, etc. and is generally used in combination with a grass herbicide (see above). Carryover more likely to occur on light soils, in dry years and from late or postemergence applications. Read label for atrazine uses. Other formulations of atrazine are available.
	AATREX NINE-O			
Preemergence annual and broadleaf weeds	PRIMEXTRA LIGHT (DUAL + ATRAZINE)	5.8 to 7.7 L/ha	-	Higher rate should be used on heavy soils.
	PRIMEXTRA II MAGNUM	3 to 4 L/ha		
Postemergence	BASAGRAN 480 Sn	1.75 to 2.25 L/ha	-	Postemergence only when corn is at 1 to 5 leaf stage. Reduce ASSIST to 1 L/ha under hot, humid

Including triazine resistant strains, primarily broadleaf control	plus ASSIST	2 L/ha		conditions. Control is best when broadleaf weeds are small and actively growing. A split application will control some broadleaf perennials like Canada thistle. Does not control weeds germinating after application.
	BASAGRAN FORTE	1.75 to 2.25 L/ha	-	No Adjuvant required.
	LADDOK plus ASSIST	3.0 to 4.0 L/ha 1.0 L/100 L of spray solution	-	LADDOK is a mixture of BASAGRAN and atrazine, it will give some residual control and will control emerged triazine-resistant biotypes. If Dual was applied preemergence, reduce Laddok rate to 2.0 to 2.5 L/ha.
	PARDNER 280 EC	1.0 to 1.2 L/ha	-	Postemergence only for control of broadleaf weeds, including triazine-resistant biotypes. Apply when weeds are in 1 to 4 leaf stage and corn is at the 4 to 8 leaf stage. Severe leaf burn may occasionally occur; however, yields have not been affected.
	ATRAZINE 500 plus LENTAGRAN 45 WP	2L/ha 1.0 kg/ha		Lentagran has not been tested adequately in Atlantic Canada, however, this treatment is considered to be excellent on triazine-resistant weeds, such as Redroot Pigweed and Lambsquarter.
Insects ▲ to Top				
Seed corn maggot Wireworm	COUNTER 15 G	75 g/ 100 m of row	-	Apply only at seeding.
	FORCE 1.5 G	75 g/ 100 m of row	-	
	-	-	-	See also "Seed treatment"
Corn earworm	POUNCE 384 EC	275 to 375 ml/ha	1	Monitor for adult moths using pheromone traps. Apply an insecticide to protect the fresh silks when the first moth is captured. Repeat spray every 3 to 5 days depending on the abundance of moths, and weather factors. Alternatively, begin spray program two days after the first silks appear. Stop spraying when silks dry up.
	RIPCORD 400 EC	175 ml/ha	5	
	LANNATE L	1.8 to 2.6 L/ha	3	
	SEVIN 85 WP	1.25 to 2.0 kg/ha	1	
	SEVIN 80 SP	1.5 to 2.24 kg/ha	1	
	SEVIN 50 WP	2.24 to 3.36 kg/ha	1	
	SEVIN XLR	4.0 L/ha	1	
	SEVIN L 420 SU	2.5 to 4.0 L/ha	1	
	DECIS 5.0 EC	250 to 300 ml	5	Do not apply more than twice.
European corn borer	FURADAN 480 F	1.1 L/ha	-	Use pheromone traps placed in weedy margins of fields to detect adult emergence. Watch for pinhole feeding on leaves of corn. Apply one of the

	LANNATE L	2.6 L/ha	3	insecticides listed or those listed for corn earworm. Repeat every five days. Direct spray into the whorls, use at least 1100 l/ha of water.
	ORTHENE 75%	0.75 - 1.1 kg/ha	21	
	RIPCORD	175 mL/ha		
Fall armyworm	as for corn earworm		-	Apply early in the morning when dew is present. This insect is usually present late in the summer
Diseases ▲ to Top				
Three-Leaf Dieback	DCT Seed Treatment	125 g/25 kg seed	-	Follow manufacturer's directions
Rust	BRAVO 500	3.2 L/ha	14	Maximum of 2 applications per year. Apply when symptoms first appear and then again 10 to 14 days later.
	TOPAS 250 E	500 ml/ha	14	Apply when rust first appears and 14 days later if necessary.
Northern and Southern Corn Leaf Blight *Helminthosporium* Leaf Spot Eye Spot Grey Leaf Spot	TOPAS 250 E	250 to 500 ml/ha	14	Apply when disease first appears. For Eye Spot and Grey Leaf Spot use the higher rate.